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Fast-growing forest plantations as a solution of regional sustainable development in the face of climate change?

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Topic: Climate change, Welfare, and Mitigation measures

Abstract

For a few years now, planting forest has been encouraged as a solution for mitigating climate change, what it is confirmed and specified by the literature review conducted in this article. Different types of plantations exist and the author is interested in those formed by fast-growing species, which are the most controversial. The purpose is to question if this mitigation measure can be a solution for regional sustainable development. The research was conducted in France, focusing on poplar and maritime pine plantations in the region Centre-Val de Loire. It mixed spatial analysis, observations *in situ* and interviews with stakeholders of the forestry-wood sector, inhabitants, hikers and tourists. The processors are faced with competition and, as a result, they invest and turn to niche markets. The regional territory could benefit more from the resource which is partly exported. The author shows that the willingness to mitigate climate change creates a new dynamic, beneficial to the forestry-wood sector. Indeed, the stakeholders of this sector are emphasizing the ecological nature of their production. Nevertheless, this is not enough to allow a sustainable development. The social aspects must be taken into account, all the more since forest plantations are part of the landscapes used by inhabitants and tourists. Being dispersed, forest plantations leave these users indifferent, strong opponents being rare. These plantations can be places of recreational activities. They are at least crossed, without being sought, but not avoided either.

Keywords: sustainability, climate change mitigation, welfare, poplar, pine.

Introduction

For a few years now, planting forest has been encouraged as a solution for mitigating climate change. Many countries around the world are therefore embarking on large-scale planting programs. Such programs are not new. In France, they date back to the 19th century and, after the Second World War, reforestation was again encouraged with the establishment of the national forestry fund. Some countries have made reforestation a key element of their forestry activities and, by the same token, of environmental protection and rural development. This is the case of the Vietnamese government since the 1990s. It then received the support of foreign and international organizations, which also based their development aid on the distribution of seedlings (Amat *et al.*, 2010; Robert, 2011). Among international institutions encouraging forest plantations, there is the United Nations: in its 15th Sustainable Development Goal, focused on “life on land”, it indicated in its website: “plant a tree and help to protect environment” (from Robert, 2020, transl.); currently, it is still written on its website, for the goal target 15.1: “By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally” (UN¹). As mentioned by P. H. S. Brancalion & K. D. Holl (2020), “reforestation is also a central component of the national commitments to the Paris Climate Agreement and of the United Nations’ Sustainable Development Goals and Decade on Ecosystem Restoration (2021–2030)”. As a result, the planted area has increased in the world, from 168 million ha in 1990 to 278 million ha in 2015 (Keenan *et al.*, 2015). Nevertheless, this area remains relatively low and various (especially in term of species, all the more since these figures concerning “planted forest” in fact include rubber plantations). Different categories of forest plantations can be distinguished, but “very few attempts have been made to propose typologies and to strictly define categories for such man-made ecosystems” (Batra and Pirard, 2015). In this article, we will focus on the forest plantations formed by fast-growing species. These plantations are the most controversial, criticized because they are monospecific and thus at the opposite of biodiversity. They are “man-made ecosystems” and some consider that they are not forest². They thus question our representation of nature (Robert, 2021). In the French Centre-Val de Loire region, in particular along the Loire River, which was partly inscribed on the Unesco world heritage list, the criticism against forest plantations is also linked to landscapes: poplar plantations “close” landscapes, preventing to see beyond (Robert & Tebonou, 2020). This fast-growing species will be at the heart of this article, with maritime pine, which is also planted in the French Centre-Val de Loire region, the studied area. To what extent are the forest plantations formed by fast growing species a solution of sustainable development in the face of climate

¹ <https://www.un.org/sustainabledevelopment/biodiversity/>, accessed on 04/13/2023.

² For example, <https://www.rainforest-rescue.org/petitions/772/plantations-are-not-forests>, accessed on 04/13/2023.

change? After a literature review, we will specify the methodology we followed, then the results.

Literature review

Forest plantations are encouraged to mitigate climate change. But we have to mention on the one hand that the amount of sequestered carbon from forests depends on the age of the plant formation, the species that form it, its management, etc. On the other hand, this management and more generally forest activities emit greenhouse gases. The sequestered carbon is then stored in wood, but the use of this one will also influence the role of forests and forest plantations in climate change mitigation. If it is as for energy production/as firewood, the sequestered carbon will be released into the atmosphere. If it is as timber, the sequestered carbon will be stored longer. But we can argue – and this is what the forestry and wood industries are putting forward – that, in both cases, the use of wood is a solution for avoiding greenhouse gas emissions: “when wood products or forest bioenergy substitute for fossil fuels and fossil fuel-intensive materials, such as concrete, steel or plastics, greenhouse gas emissions can be reduced in other sectors” (Lindner, Hanewinkel & Nabuurs, 2017). As a result, “climate change mitigation objectives are increasing demands for wood-based bioenergy and the use of wood in construction and industrial systems” (Keenan, 2015). In this way of avoiding CO₂ emissions, forest plantations can play a key role, as we consider that, despite their small area worldwide, “plantations supply a third of the global industrial demand for roundwood with projections to achieve 50% by 2040 (Jürgensen, Kollert, & Lebedys, 2014)” (Brancalion & Holl, 2020). Finally, we must also consider that forests are affected by climate change, what it is studied since Emanuel *et al.* (1985), Pastor and Post (1988) and Cannell *et al.* (1989) (Keenan, 2015). Some consequences are positive, but many are negative, in particular because of the rapidity of climate change, according to R. J. Keenan (2015), who counted 1.172 papers about “climate change impacts and adaptation in forest management” mainly published between 1986 and 2013; 76% of these papers “involved assessment of climate change impacts or the sensitivity or vulnerability of forests to climate change and 11% (130) considered adaptation”. Planting species coming from areas with the same climate as the one to come in the more or less near future can be a way to adapt local forests.

In France, “with 130 MtCO₂eq stored or avoided every year, the French forest-wood sector is a major stakeholder of the climate change mitigation” (Roux *et al.*, 2020, transl.). But the choice of strategies for the future is not simple. Mitigations and adaptation are “obviously inextricably linked (Innes *et al.* 2009)”, but “Locatelli *et al.* (2011) [...] argued that mitigation projects can facilitate or hinder the adaptation of local people to climate change, whereas adaptation projects can affect ecosystems and their potential to sequester carbon” (Keenan, 2015). Roux *et al.* (2020) highlight also the

possible contradictions between strategies and, in this case, two opposite views about the role of forestry-wood sector in climate change mitigation: the willingness to promote and thus increase carbon sequestration and the willingness to develop bioeconomy, which implies to use more wood as bio-sourced and renewable resources, to avoid greenhouse gas emissions. They are incompatible, because the last one implies to increase wood logging. A. Roux *et al.* (2020) studied three scenarios until 2050, privileging the one or the others, from extensification to intensification, with an intermediate, applied to the case study of France. The intensification scenario would imply “to create new resources, very productive and easily mobilized by the bio-economy”, thus to develop forest plantations by fast-growing species, which we studied here (*ibid.*, transl.) – the authors mention the example of poplar plantations. “The idea is to dedicate a small part of the forest area to some forestries, where the purpose of production is assumed and well stated” (*ibid.*, transl.), what reminds the situation of forest lands in Vietnam: each one has a precise objective, which can be production (Robert, 2011). This scenario of intensification is the best one from economic point of view, with advantages in terms of employments and economic gains. But it requires changes in consumption and structural adaptations for industries (Roux *et al.*, 2020).

The economic purpose is often the first one linked to forest plantations, especially if they are formed by fast-growing species and we see that it is still true in the face of climate change. According to Brancalion & Holl (2020), even if “peoples’ motivations for planting trees are varied [...] Tree planting is often economically motivated to provide timber and/or non-timber forest products”. It is thus a way for economic development, followed by some countries like Vietnam. But the fast-growing forest plantations have inconvenience, as shown by this example: “in the short-term, planted forests are vulnerable and prone to erosion” and “in the long-term, planted forests may jeopardise spontaneous reforestation” (Amat *et al.*, 2010). More generally, “tree planting [...] can have unintended negative consequences at multiple scales” and “the balance of positive and negative effects depends strongly on where and how tree planting is done” (Brancalion & Holl, 2020). We must consider that:

“a large number of tree planting initiatives are based on industrial monocultures of exotic trees, mostly pines and eucalypts (Lewis, Wheeler, Mitchard, & Koch, 2019), which may result in marked trade-offs between timber production and biodiversity”.

Moreover, “tree planting has a storied and passionate place in the psyche of many human cultures” (Brancalion & Holl, 2020). In France, poplar plantations are among the most controversial plantations as they are the most artificial ones, marked by alignments of their trees. Ecologists consider them as a “ligniculture” (*i. e.* cultivation in line) and not as a forest (Arnould, 2004). Indeed, it is an agro-industrial forest, considered as a “new

forest” by P. Arnould (*op. cit.*). Other opponents are the defenders of landscapes, particularly in the Loire Valley (partly listed as a Unesco World Heritage Site). They blame poplar plantations for denaturing and closing off landscapes (Robert & Tebonou, 2020). In 1990’s-2000’s, the oppositions were particularly strong in some areas, like in the Low Anjou valleys (Basses vallées angevines). But the rejection of poplar plantations appears much more “visceral” than “objective”, according to S. Le Floch (1996). Poplar growing is then seen as a “threat”. It is above all a structured industry against which it is possible to express grievances (Robert & Tebonou, 2020). Poplar plantations thus crystallize debates that go beyond them (*ibid.*): the closing of landscapes, to which they therefore only participate, showing the “social death of a rural society” (Le Floch *et al.*, 2005, transl.). This situation leads P. Arnould (2004, transl.) to affirm that poplar growing is an “economic success” for a “nationally and internationally structured industry” but it is confronted with “an ecological failure and a social rejection”. Today, the planted surfaces tend to decrease and the oppositions have diminished, but without disappearing. Another emblematic forest plantation, formed by fast-growing species, is the plantation of maritime pine. It is the other one associated to “ligniculture”, in other words “intensive forestry”, “for wood production”, in the Larousse French dictionary. The French literature about poplar is weak or dated, especially on economic and social aspects. It is even rarer on maritime pine. According to V. Moriniaux (1999, transl.), resinous are unloved by French and the oppositions are old, dating from the XIXth century and finally, “behind modern ecological arguments, motivations inherited from another period are hidden”. Nowadays, the oppositions are “an attitude of city dwellers, which don’t know the realities of the forest, but are attached to the image they have of it” (*ibid.*, transl.). Moreover, resinous “are hated by many environmentalists”, just like poplars (Arnould, 2004, transl.).

Our research completes this existing literature by questioning the role of forest plantations (poplar and maritime pine plantations) in the regional sustainable development, considering the interest in terms of economy and well-being, in the current context of climate change.

Methodology

This article is based on research conducted in the Loire Valley in France, as part of research projects. The first project was funded by the French Ministry of Agriculture (Poplar for the Future, 2018-2021) and the concerned work package was about poplar plantations and their landscapes (dynamics and representations). The second project (Plantaclim, 2021-2024) is still in process; it is funded by the French Region Centre-Val de Loire and aimed at “Maximizing the services of forest (re)plantations in the context of climate change”, focusing on the plantations of poplar and maritime pine. A third project consisted of a more general reflection on worldwide forest plantations, in

particular poplar plantations in France and acacia plantations in Vietnam. This reflection was conducted from the results of an on-line questionnaire but, given the importance of French respondents compared to other nationalities, we consider these results mainly to shed light on the French case. This project was entitled “Representations and reality of planted forests (Reforesté)” and it was funded by Maison des Sciences de l’Homme [House of human sciences]-Val de Loire.

In this article, we focus on research conducted in the French region Centre-Val de Loire. It was chosen because its position is median in terms of forest area and standing timber volume, being in 5th place (on 13 regions in metropolitan France) in terms of the quantity of wood removed, with approximately 2.4 million m³/year (IGN, 2016). 80% of its forests are deciduous (mainly oaks; *ibid.*). The region Centre-Val de Loire is thus not among the French regions, which are already concerned by the decied large monospecific plantations, especially formed by resinous. Nevertheless, forest plantations are present, in particular maritime pine plantations and poplar plantations, which were and still are at the center of controversies (Robert, 2021).

In the French region Centre-Val de Loire, we paid attention to the dynamics of the studied forest plantations (maritime pine and poplar), known thanks to the analysis of vector databases and processing of aerial photographs made available by IGN (French national Institute of geographical and forestry information). These sources were completed by observations *in situ* and interviews with local stakeholders, to know especially the recent dynamics, linked to the deeper awareness of climate change, since 2 or 3 years. Moreover, interviews were conducted in a semi-supervised manner with 53 inhabitants, 19 hikers, 69 tourists and 23 stakeholders of the forestry-wood sector: 12 forest owners (mainly of poplar groves), a representative of FiBois (interprofession of the forestry-wood sector) Centre-Val de Loire, 2 nurserymen, 2 operators, a forestry expert and 5 processors. In addition, we had regular exchanges with representatives of ONF (National office of forests), the CNPF (National center national of forest ownership), the association “Peupliers du Centre-Val de Loire” (an association of owners and other stakeholders of the poplar sector), partners in the project such as FiBois Centre-Val de Loire. The purpose of these interviews was to know the representations of forest plantations, the practices conducted in or around these plantations and the situation of forestry-wood sector. We must note that the plantation opponents (landscapers, representative of an association for the protection of nature, etc.) were also interviewed, but the results will not be mobilized here (see Robert & Tebonou, 2020).

In addition, we will mobilize the results of an on-line questionnaire, which was defined by the international and interdisciplinary team of the project intituled Reforesté. The objective was to identify the representations associated with forest plantations. The questionnaire was distributed in French, English and Vietnamese, what allows to obtain

205 answers. The majority of respondents were French (82.5%); there were also Vietnamese (8%) and people of other nationalities (9.5%), including Belgians, Swiss, Italians, South Africans, etc. Because of the way of dissemination (the networks of the involved partners), the respondents were mainly experts: 47% were researchers and engineers, but not necessarily specialists in the subject (foresters, etc.).

Results

Like at the national scale, forest area increased since a century in the region Centre-Val de Loire: the average is 2,000 ha/year (ONF³). As a result, the current forest area is 927,000 ha (24% of the total area; IGN, 2016). Poplar plantations area is not included in forest statistics – being between forests and crops – and varies according to sources: we can consider that it is about 18,400 ha (IGN, 2018) and they thus represent 1.93 % of the forest area (in which the poplar plantations area is then added). Maritime pine plantations have a similar area, representing 1.95% of the regional forest area. The two plantations are undergoing distinct evolution. Like at the national scale, the poplar plantations were strongly extended after the Second World War. But since 1990's, the harvested plantations are not all replanted and the poplar plantation area decreases, so much so that the poplar sector fears a shortage. For the last 2 or 3 years, replanting is on the rise again, what is visible in the field, even if the stakeholders of the poplar sector insist on the fact that renewal is still only partial. Moreover, they see that poplar plantations are not affected by climate change – only the plantation on the least adapted stations is abandoned, in particular on the plateaus. The area of pine maritime plantations was also increased after the Second World War. For the last 2 or 3 years, there has been a renewed interest because maritime pine is resistant to the current climate change, what is not the case for chesnut, oak and Scots pine, which are affected by dieback. As a result, the area of maritime pine plantations is currently increasing, knowing that this species replaces deciduous species only when any attempt at regeneration fails.

In the region Centre-Val de Loire, 2.4 million m³ are harvested each year, what is below the biological production of the regional forests (IGN, 2016). Despite this, the harvesting of these forests is only partly achieved by regional forestry companies. Due to the economic competition, their number has decreased, as the one of the processing industries has too. Thus, in 2016, more than 50% of harvesting was conducted by companies headquartered outside the region (AGReSTe Centre-Val de Loire, 2019). The statistics are not available by species, but our observation and the interviews we conducted confirm that a part of poplar wood is exported, sometimes processed in industries located outside but close to the regional boundaries – case of two interviewed processors. Maritime pine wood is only processed outside the region (mainly in the

³ <https://www.onf.fr/+6e::onf-en-region-centre-val-loire.html>, accessed on 08/10/2022.

south-west of France where maritime pine plantations are much more extensive). However, one of the processors interviewed outside but close to the regional boundaries does process some and one of the processors in the region recently modified its processing lines to adapt to maritime pine wood (whose trunk is more tortuous than the one of Scots pine, which is processed more in the region). The fact that a part of wood is exported outside the region reduces the economic interest of forest plantations. However, the forestry-wood sector is aware of the role to be played in climate change mitigation, particularly in the context of avoidance strategies. It thus puts forward the ecological advantages of wood. The consequence is an increase of demand for wood. It is particularly noticeable for poplar wood, which is increasingly peeled for the manufacture of light packaging or plywood, according to the representatives of the poplar sector and in particular the interviewed processors. These stakeholders testify to their dynamism: comforted by the current developments, they are investing, even if they also specify that these investments are imperative to maintain their activity. Only those who have remained in a more traditional production, in this case that of the box, are experiencing difficulties. The others also perceive these difficulties, linked to the economic competition, but they try to overcome them by turning to niche markets. Forests and in particular forest plantations could contribute more to the development of the region, if wood was processed more locally. But this requires aid, especially in terms of investment, because companies are struggling to remain competitive. The number of companies has decreased over the past thirty years, as the interviewed stakeholders attest. The current context reflects a growing desire to mitigate climate change, which is accompanied by an interest in local resources, allowing to reduce CO₂ emissions due to transport. It is thus favorable for a redeployment of local processors, all the more since the local resources exist, with a doubt for poplar wood: needs are growing and they thus contribute to the risk of shortage that the poplar sector fears.

To propose a solution in favor of a sustainable development, we know that the economic aspect is not enough, even if it is crossed with environmental aspects, here linked especially to climate change: the well-being of the local and visiting populations must be taken into account. Here, we would like to insist on this aspect. What do inhabitants and tourists think about forest plantations? Can these plantations contribute to their well-being, by offering cultural ecosystem services, being places for recreational activities?

Inhabitants were more specifically questioned about poplar plantations. 25% of them consider that these plantations have a positive impact on the landscapes, against 16% attesting that the impact is negative. In both cases, they highlight the alignments of trees and the maintenance (regular cutting of the understory vegetation). They are more numerous to think that the impact on the environment is positive (61%), what is linked to the benefits associated with trees: forests are considered as “green lungs” of the

planet. But 12% of these inhabitants regret the loss of biodiversity and the worsening of the drought, as poplars would pump a lot of water. In general, they consider that poplar plantations are a necessity, but they prefer that they are disseminated (68%) and have a more natural appearance, with a denser understory.

To know if the forest plantations can be places for recreational activities, we overlaid the location of the studied plantations with the hiking trails in a geographic information system. By this way, we have the confirmation that plantations can be crossed by these trails and they can thus offer cultural ecosystem services. Moreover, in the field, the presence of watchtowers shows that hunting is also practiced there, knowing that it is especially for leisure purposes. Concerning hiking, the presence of plantations is not sought, but not avoided either; it is only secondary, according to an interviewed person who organizes hikes. Only 16% of the hikers assert that plantations have a negative impact on their activity. Among the others, some consider that forest plantations are aesthetic and thus improve landscapes, contributing to their diversity, especially in the open agricultural spaces. Interviewed hikers are local, but they appear to be more critical than the other interviewed residents, maybe because they seek a proximity to nature, which is revealed by their hiking activity. They consider forest plantations as too artificial, with differences according to the sites and notably the history of the plantations.

We also interviewed cyclotourists. Most of the time, they did not pay attention to the presence of forest plantations along their route. Like the inhabitants, they appreciate the fact that these plantations contribute to landscape diversity and therefore prefer when they are scattered. They are rather indifferent, with the idea that plantations are part of landscapes, with a production objective. If they are appreciated, it is for the shade or considering that we “need to plant more trees for our planet”, knowing that “all trees are necessary, but I prefer wild forest”. Like inhabitants, they prefer plantations, which appear more natural (with a dense, shrubby understory). Plantations with a regularly cut understory are, however, appreciated for their walkability.

The answers to our on-line questionnaire allow to widen the reflection. 48% of the respondents are in favor of an increase of forest plantations area, but 69% think that measures are needed to improve fast-growing forest plantations. Only 25% consider that planting fast-growing trees on large areas should be promoted. Indeed, “concentrating plantations” appear as the worst solution, whereas “favoring agroforestry” is considered as the best one. Plantations with a dense understory are again preferred.

Conclusions

Forest plantations are encouraged to adapt forests to climate change and to mitigate this change because their trees and their soil sequester carbon. They also provide resources

whose use can be part of avoidance strategies, as they replace energy-intensive materials (e. g. concrete) and fossil fuels. This is especially true if these resources are local, avoiding thus transportation-related emissions. But some limits have to be taken into account: loss of biodiversity, vulnerability to natural hazards, etc., especially if forest plantations are formed by fast-growing species, like poplar and maritime pine in France or acacia in Vietnam. This article focused on the first ones, questioning their possibility to contribute to regional sustainable development. The context of climate change, and above all the awareness of this change and the willingness to mitigate it are favorable for forestry-wood sector and the use of wood harvested in the studied forest plantations. These ones can thus contribute to the regional development but, to face the competition, processors need turn to niche markets and invest regularly. The resources are necessary but not sufficient, as shown by the situation of the forestry-wood sector in the region Centre-Val de Loire: half of the wood is harvested and processed outside the region, which reduces the economic benefits for the region and its population. This is even more important for maritime pine, which was not previously processed in the region. But, faced with the interest in this species, which is more resistant than other species previously favored, processors are starting to change their processing chain. Poplar is also relatively unaffected by climate change and appears to be a species with a future for the poplar sector. But, since 1990's, it has suffered a decline in its surface area, which poses a risk of shortage, especially since the demand for wood is growing: renewed interest in poplar wood is already perceptible, especially since the poplar sector is emphasizing the ecological nature of its production. Nevertheless, this is not enough to allow a sustainable development. The social aspects must be taken into account, all the more since forest plantations are part of the landscapes used by inhabitants and tourists. Only a few of them are strongly opposed. Most of them are quite indifferent. They consider that forest plantations are part of landscapes; being dispersed, these plantations contribute to the diversity of the landscapes which they appreciate. They are aware that forest plantations are production areas and are not really forests. They regret the artificial character and thus prefer plantations with a dense and shrubby understory. Nevertheless, forest plantations can be places for recreational activities; at least, they are crossed by hikers: their presence is not sought but not avoided either. We plan to continue this research in other field, starting with Vietnam, a country that has given priority to plantations since the 1990s (Robert, 2011): the economic success is undeniable but what about on the social and cultural level?

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